ALL ABOUT THAT PREY?
HABITAT ASSOCIATIONS OF THE SEABIRD COMMUNITY IN THE NORTHEASTERN CHUKCHI SEA
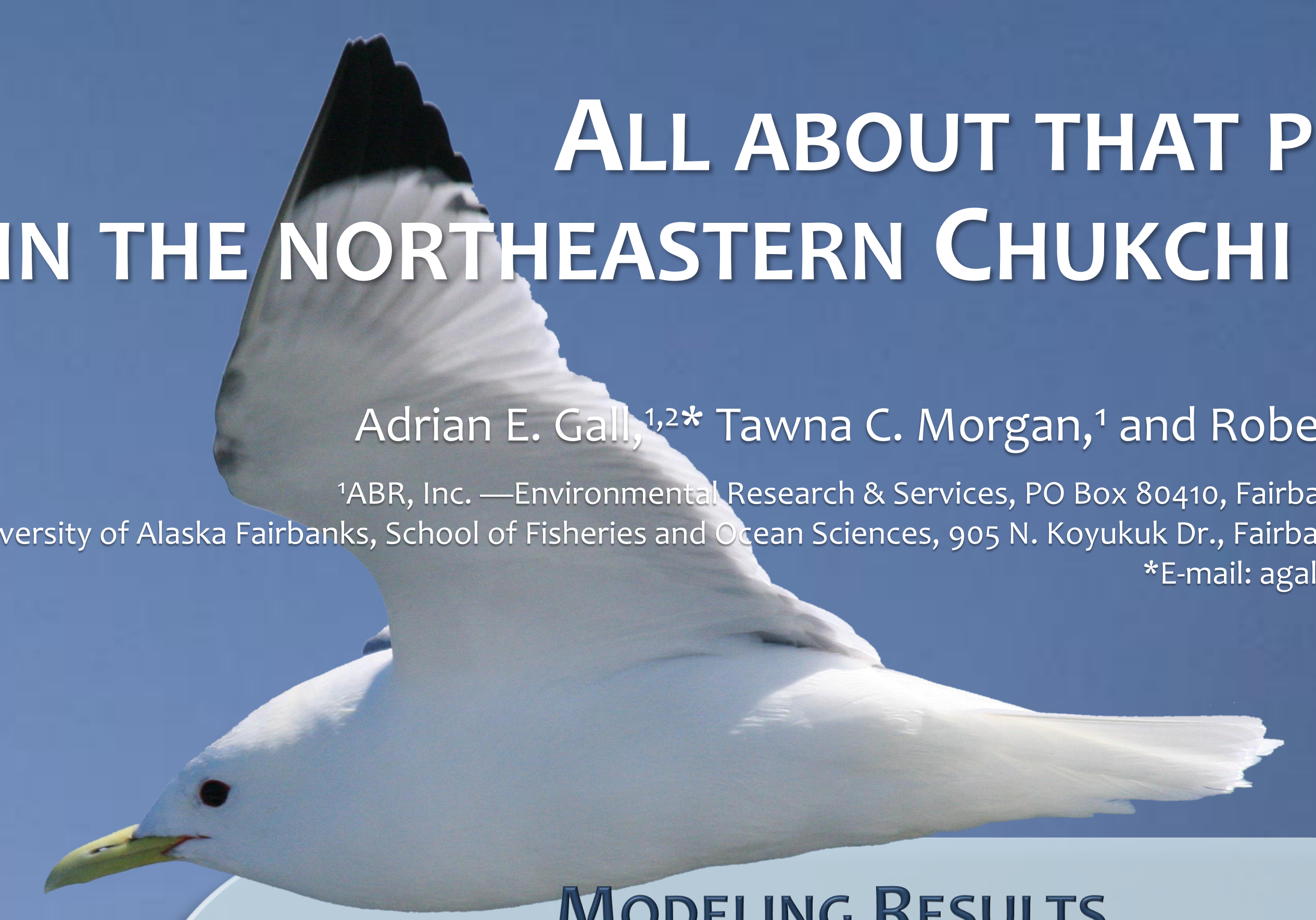
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INTRODUCTION

Seabirds rely on oceanographic processes such as fronts to facilitate foraging. Identifying elements of the marine habitat that are associated with seabird distribution can reveal mechanistic links. Habitat can be defined by direct variables which affect the physiology of seabirds (e.g., prey availability) and indirect variables which characterize the physical habitat. An understanding of current ecosystem function and ongoing changes in the Chukchi Sea is needed to assess any potential impacts from future oil and gas exploration and development activities.

Objective: What oceanographic features influence spatial and temporal variation in seabird abundance?

METHODS

- Surveyed birds and oceanography during September 2011 and September 2012
- Recorded all bird observations on a laptop that georeferenced and time-stamped records
- Measured vertical profiles with a Seabird, Inc. SBE-19+V2 CTD sampling at 4 Hz
- Sampled zooplankton with 505 µm nets towed obliquely at 5 kt
- Interpolated oceanographic covariates to a 3-km grid
- Split line transects into 3-km segments
- Modeled habitat of 8 species of seabirds using generalized additive models (GAMs)
- Species-specific models pooled both years
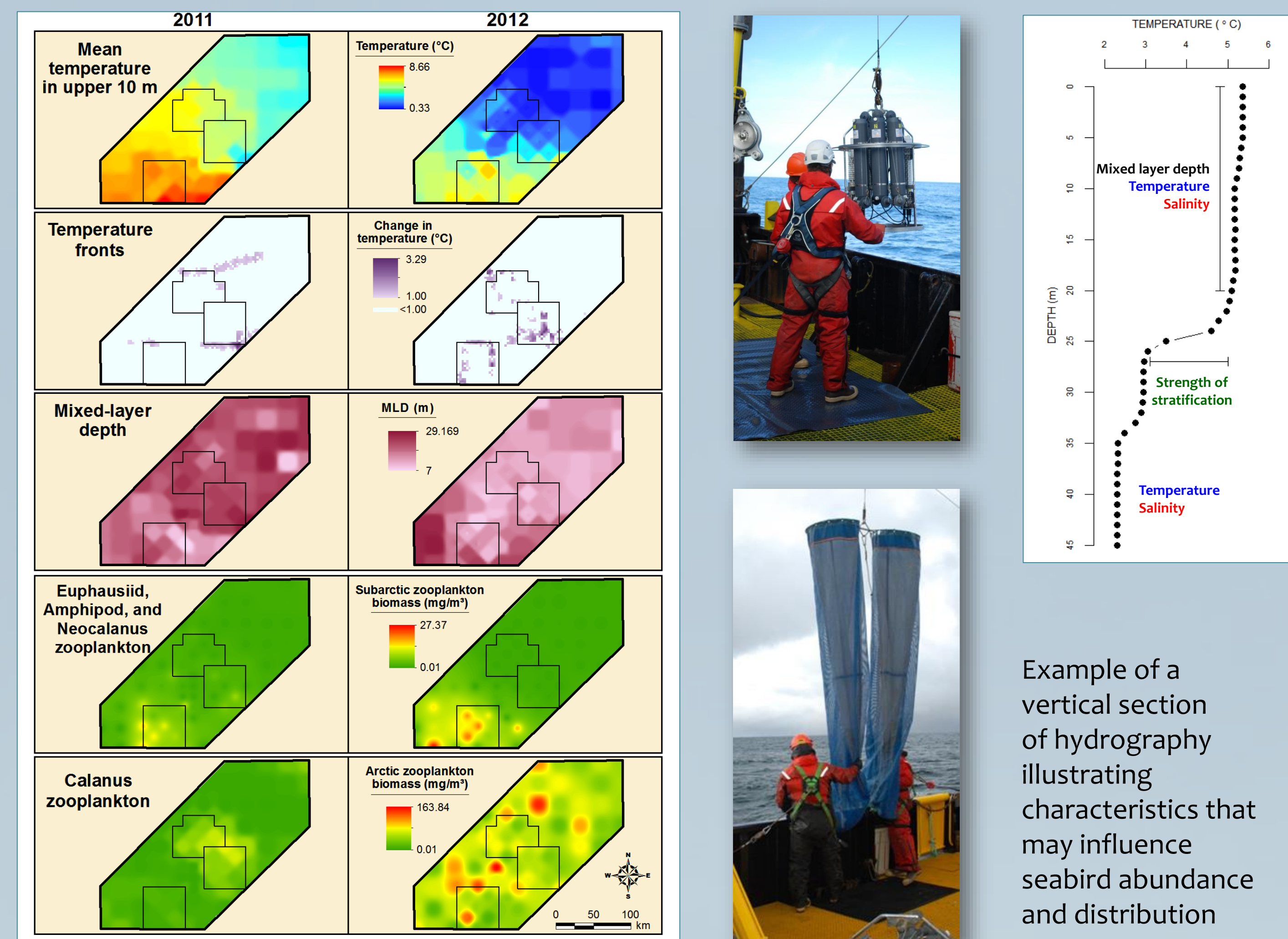- Best model for each species selected from suite of 27 models using AIC
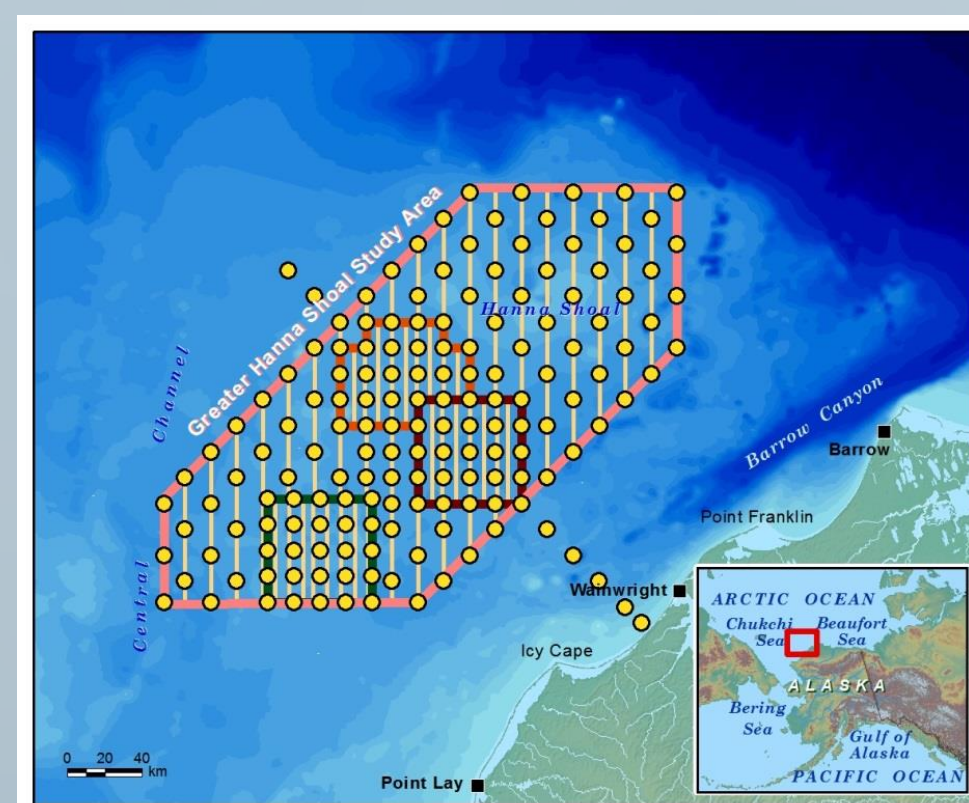
Transects and stations sampled

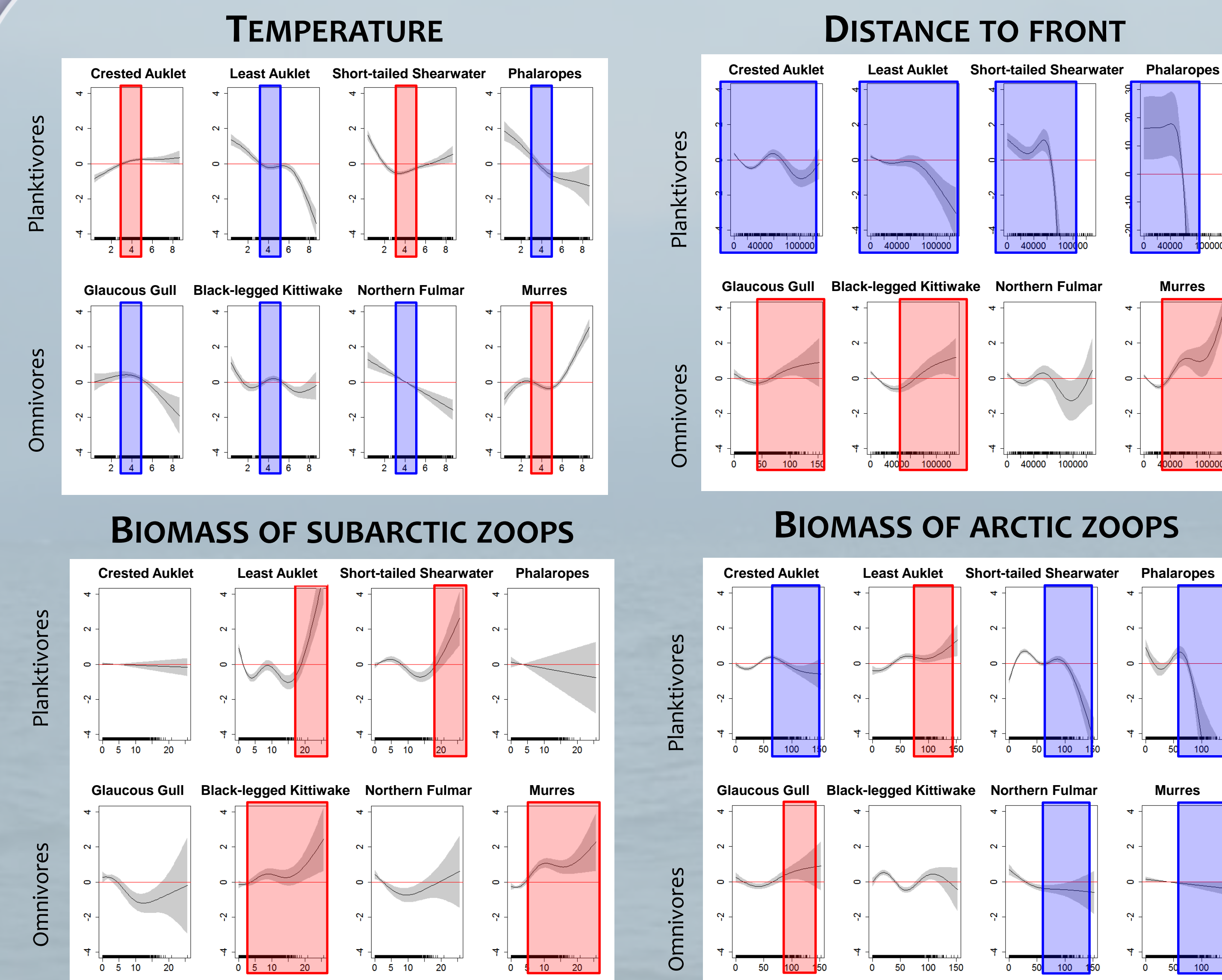Table 1. Sampling effort and number of individuals recorded during Sep 2011 and Sep 2012.

Samples	2011	2012	Total
Transects (km)	3,216	3,204	6,420
Stations	81	70	151
Crested Auklets	5,794	5,490	11,284
Least Auklets	157	1,393	1,550
Short-tailed Shearwaters	1,890	1,747	3,637
Phalaropes	74	152	226
Northern Fulmars	85	151	236
Glaucous Gulls	97	94	191
Black-legged Kittiwakes	390	340	730
Murres	1,023	560	1,583

OCEANOGRAPHIC COVARIATES

2011 — 2012

- Mean temperature in upper 10 m
- Temperature (°C)
- Temperature fronts
- Change in temperature (°C)
- Mixed-layer depth
- MLD (m)
- Euphausiid, Amphipod, and Neocalanus zooplankton
- Subarctic zooplankton biomass (mg/m³)
- Calanus zooplankton
- Arctic zooplankton biomass (mg/m³)

Example of a vertical section of hydrography illustrating characteristics that may influence seabird abundance and distribution

HABITAT ASSOCIATIONS

TEMPERATURE
Planktivores: Crested Auklet, Least Auklet, Short-tailed Shearwater, Phalaropes
Omnivores: Glaucous Gull, Black-legged Kittiwake, Northern Fulmar, Murres

DISTANCE TO FRONT
Planktivores: Crested Auklet, Least Auklet, Short-tailed Shearwater, Phalaropes
Omnivores: Glaucous Gull, Black-legged Kittiwake, Northern Fulmar, Murres

BIOMASS OF SUBARCTIC ZOOPS
Planktivores: Crested Auklet, Least Auklet, Short-tailed Shearwater, Phalaropes
Omnivores: Glaucous Gull, Black-legged Kittiwake, Northern Fulmar, Murres

BIOMASS OF ARCTIC ZOOPS
Planktivores: Crested Auklet, Least Auklet, Short-tailed Shearwater, Phalaropes
Omnivores: Glaucous Gull, Black-legged Kittiwake, Northern Fulmar, Murres

Conditional additive effects of oceanographic habitat parameters that describe the abundance of seabirds in the northeastern Chukchi Sea, 2011–2012. Dashed lines represent 95% confidence intervals around fitted values.

MODELING RESULTS

Table 2. Statistical significance of environmental variables and deviance explained by models for the abundance of 8 taxa of seabirds in the northeastern Chukchi Sea, 2011–2012. P-values are approximate, based on degrees of freedom estimated by cross-validation; red text indicates a positive association ; blue text indicates a negative association; and black text indicates no consistent association. Dashes indicate that the variable was not included in the model best supported by the data for that species.

Species	Percent deviance explained	Mixed-layer depth	Temperature (Top 10 m)	Distance to front	Biomass subarctic zooplankton	Biomass arctic zooplankton
Crested Auklet	10	<0.01	<0.01	<0.01	0.51	<0.01
Least Auklet	30	<0.01	<0.01	<0.01	<0.01	<0.01
Short-tailed Shearwater	23	<0.01	<0.01	<0.01	<0.01	<0.01
Phalaropes	29	0.34	<0.01	<0.01	0.35	<0.01
Northern Fulmar	7	0.1	<0.01	<0.01	<0.01	<0.01
Glaucous Gull	9	–	<0.01	–	<0.01	<0.01
Black-legged Kittiwake	12	<0.01	<0.01	<0.01	0.02	<0.01
Murres	36	<0.01	<0.01	<0.01	<0.01	0.05

- Strong divers are more abundant in warm (>4 °C), weakly stratified water. Surface-feeding birds are more abundant in cold (<4 °C), strongly stratified water.
- Planktivores are more abundant near to fronts and omnivores are more abundant far from fronts.
- Least Auklets are positively associated with abundance of zooplankton; relationships less clear for other species

CONCLUSIONS

- Models provide insight into factors that seabirds use to select their habitat and how those relationships vary by prey preferences and foraging strategy
- Associations with temperature (and vertical structure) differ depending on foraging strategy
- Associations with fronts differ depending on prey preference
- Prey abundance can be a factor, although less reliable than physical habitat characteristics indicating processes that aggregate prey